Photoinjector and Vacuum Window Conditioning Software

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Overview

The photoinjector cavity and separately the vacuum windows need to be conditioned with RF under vacuum to the point where they will reliably sustain full CW power without breakdown.

The units are conditioned with limited-energy pulsed RF, starting at low level, where there will be breakdown initially, over time up to the point where breakdown ceases. This may take minutes to weeks to accomplish, so an automated solution is called for.

Many parameters may be varied, pulse power, length, pulse repetition frequency, etc., but to simplify the process, only one variable, the peak power level, will be controlled by the software. All other variables will be under manual control, and will be set by the operator. The peak power level will depend on monitoring a number of variables, and by looking at their history as well.

Monitored Variables

Temperature - cavity, water, windows, RF circulator
Interlocks - MPS, PPS, Amplifier interlocks
RF forward power - amplifiers 1 and 2
RF reverse power - amplifiers 1 and 2
Cavity pickup loop to look at amplitude and phase referenced to drive power
Vacuum - cavity and each RF window
Radiation level - X-rays

Software Setpoints

Peak power limit
Pulse repetition frequency (or period, 0 for CW)
Pulse length
Start RF Frequency
Frequency correction increment
Maximum pulse energy
Maximum peak power
Delay from last event for each event type
Action to be taken for each event type
Power step increment
Maximum frequency deviation before correction
Reflected Power threshold
Reflected Power detection delay
Vacuum burst threshold
Temperature limit threshold
Counts to next power increase increment

The current cavity frequency will be determined by measuring the phase difference between the RF drive and the cavity field probe. When the offset exceeds a given limit, the RF drive frequency will be corrected to follow the cavity frequency, within the limits of the maximum frequency deviation.

There will be a number of counters that record the total number of events and the number of pulses since the last event to calculate how long to hold or continue pulsing at the current level or to increase the power by the step increment.

Event Counters

	Total Events	Pulses From Last Event
Total Pulses	x	
Optical spark detector	x	x
Reflected Power	x	x
Vacuum burst	x	x
Frequency adjustment	x	x
(Others)	x	x

An event will generate a response, such as a pause for a vacuum burst, or a cutback in power, depending on the event type. If no event occurs for a specified number of pulses, the peak power will be increased by the specified step.

The software will be interrupt-driven, so that an event may terminate the RF pulse immediately. Complete time-logging will be provided of all setpoints, parameters and events.